Numerical Simulation of 8-hr Ozone Concentration in Extended Phoenix Area

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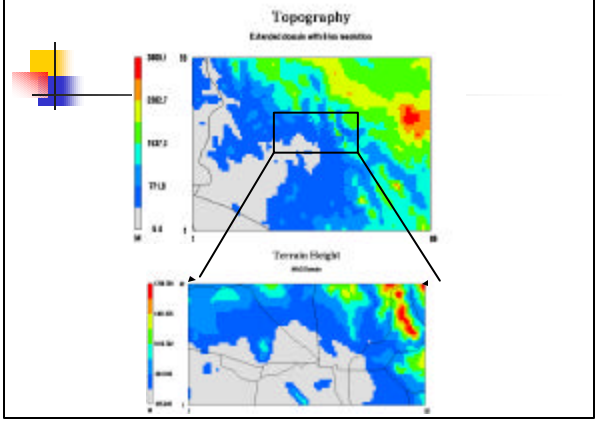
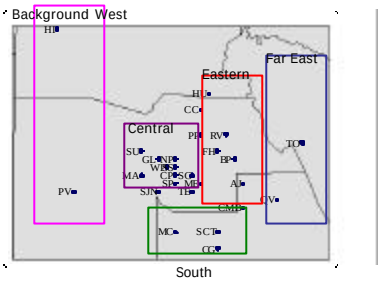
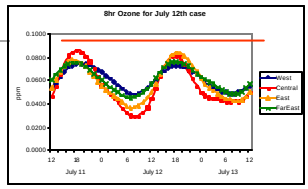


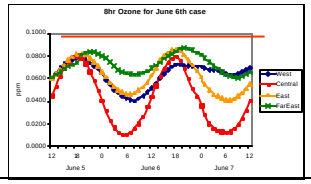
Highest 8hr Ozone: June 6th



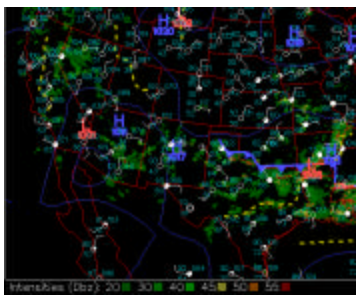
Design Days

- July 12th
  - Central valley exceeds 85ppb
- June 6th
  - Far Eastern exceeds 85ppb

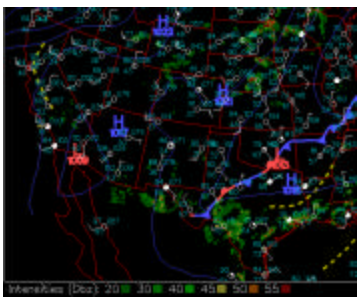




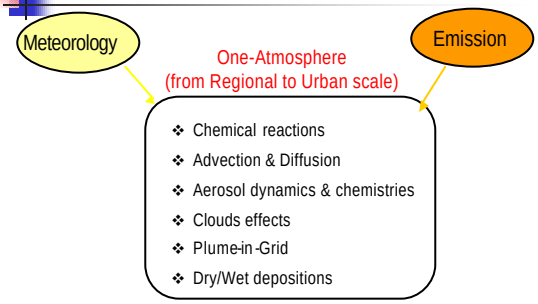
Episodes: July 12th, 2002



Episodes: June 6th, 2002



Models-3/CMAQ (Community Multi-scale Air Quality)



Models-3/CMAQ Modeling Domains

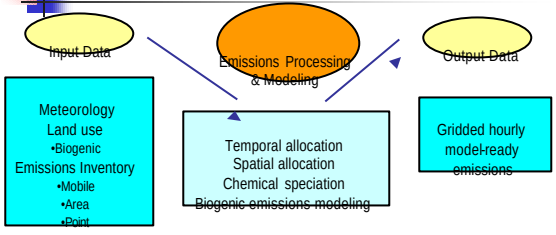
SMOKE

Sparse Matrix Kernel
Emissions Modeling System

SMOKE

- Emissions processing system for area, mobile and point sources.
- Biogenic emissions modeling.
- Provides specialized emission inputs for air quality models: gridded hourly 3-dimensional.

SMOKE



SMOKE Episodes

- June 4-7, 2002 & July 10-13, 2002.
- 6 km x 6 km modeling domain, 89 columns and 59 rows.

SMOKE Input Data

Emissions Inventory

Western Regional Air Partnership (WRAP)
1996 Base Case Scenario
County data for area, mobile and point source emissions
Inventory species: NO_x CO NH_3 SO_2 VOC

Meteorological Data

MM5 simulation results for episode days June 4-7, 2002 & July 10-13, 2002

SMOKE Input Data

Land Use Data

U.S. EPA's Biogenic Emissions Landcover Database (BELD3),1 km x 1km resolution, 230 land use types
ftp://ftp.epa.gov/amd/asmd/beld3

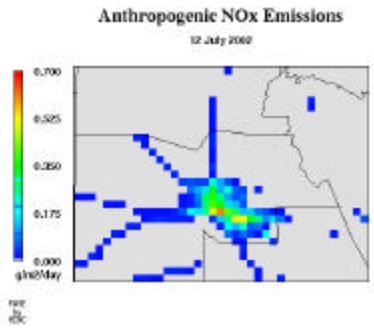
Spatial Surrogate Data

U.S. EPA's 4km Spatial Surrogate Data covering the United States
http://www.epa.gov/ttn/chief/emch/spatial/

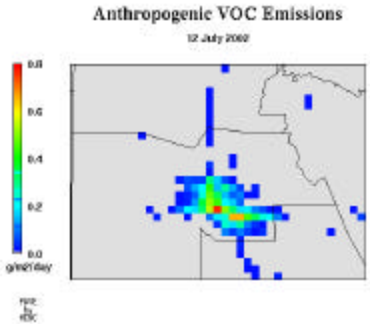
Spatial Surrogate Codes

Agriculture	Urban Area
Airports	Rural Area
Land Area	Forest Area
Housing	Urban Primary Roads
Major Highways	Rural Primary Roads
Population	Urban Secondary Rds.
Ports	Rural Secondary Rds.
Railroads	Urban Population
Water Area	Rural Population

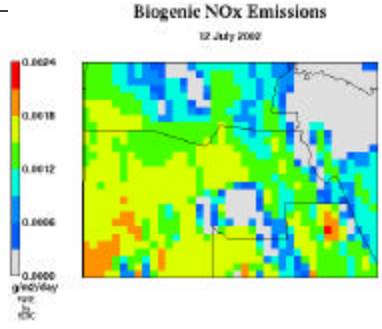
Smoke Results



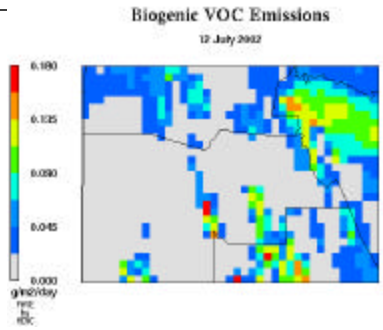
Smoke Results



Smoke Results

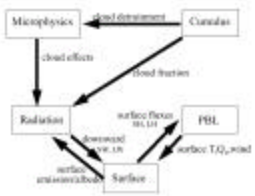


Smoke Results



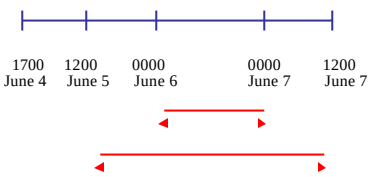
The Fifth-generation Penn State/NCAR Mesoscale Model (MM5)

- Terrain following σ - coordinate
- Non-hydrostatic dynamics
- Four-dimensional data assimilation
- Multiple nest capability
- Physics



Design of Numerical Simulation

- **Study Case: 19 hrs of spin-up for MM5**
  - →1700 LST June 4 – 1700 LST June 7, 2002
  - →1700 LST July 10 – 1700 LST July 13, 2002

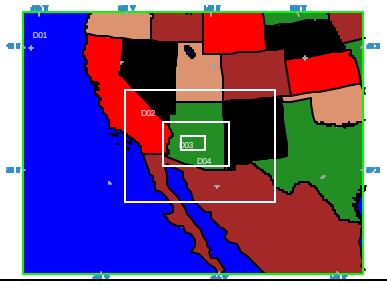


Design of Numerical Simulation

- **Spatial Dimension**
  - nested domains: 6 km -> 2 km
  - 27 vertical layers
- **Meteorological data**
  - IV & BV : NCEP Eta Analysis 40 km output
- **Emission data**
  - ASU Inventory
  - MAG '99 Inventory
- **Initial & Boundary Value**
  - '98 Field Exp – Vertical Profiles & HC data
  - Surface monitoring data

Design of Numerical Simulation

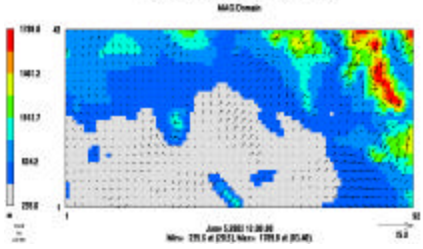
Nested Run of MM5: 54 Km → 18 Km → 6 Km → 2 Km

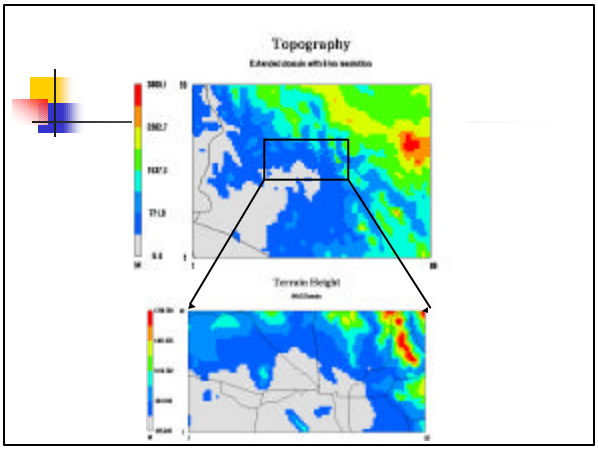


Ground Level Wind Field

1200 LST June 5th – 1200 LST June 7st

Topography & Surface Wind

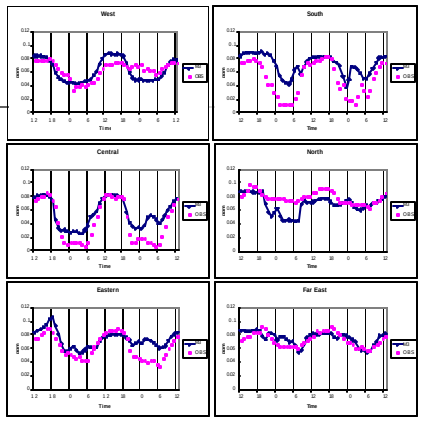




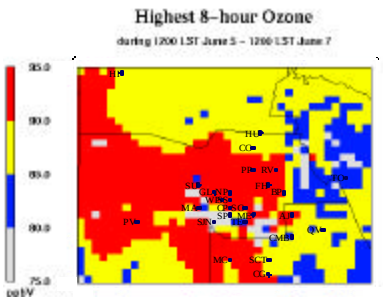
8hr Averaged Ozone: June 6th

June 6th

Model vs. Obs.



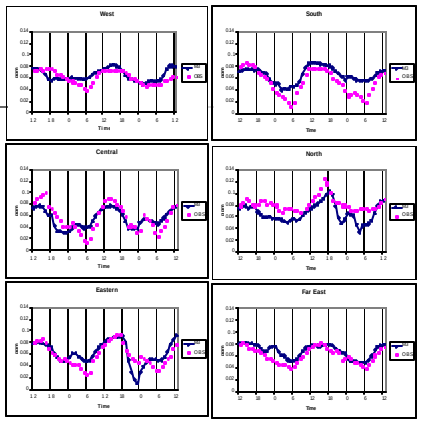
Highest 8hr Ozone: June 6th



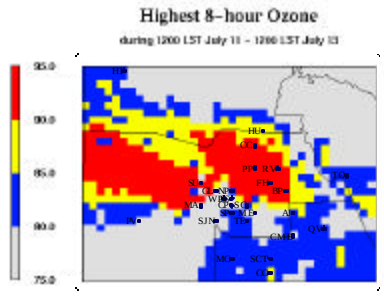
8hr Averaged Ozone: July 12th

July 12th

Model vs. Obs.



Highest 8hr Ozone: July 12th



Summary

1. CMAQ prediction agrees reasonably well compared to observations. The model performance met EPA guidelines for model validation.
2. The highest 8-hr ozone concentration was predicted for the central valley as well as the west of the valley.
3. The bulk of the domain violated the 8 hour ozone standard.